FORM PTO-1390 (REV 10-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C.371

ATTORNEY'S DOCKET NUMBER	
MCW-003US	
U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	09/890681
INTERNATIONAL APPLICATION: PCT/GB00/00332	INTERNATIONAL FILING DATE: 07 February 2000 (07.02.00)
PRIORITY DATE CLAIMED: 05 February 1999 (05.02.99)	

TITLE OF INVENTION
BURNER FOR FABRICATING AEROSOL DOPED WAVEGUIDES

APPLICANT(S) FOR DO/EO/US
Paulo Vicente DA SILVA MARQUES et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C.371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. ☐ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C 371(c)(2))
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). **(unexecuted) (4 Sheets);**
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98 **(2 sheets) with Form PTO-1449 (1 sheet);**
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included
13. ☒ A FIRST preliminary amendment **(3 sheets) (along with version of markings to show changes (2 sheets));**
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: **Transmittal Letter (2 sheets); PCT International Published Application (WO 00/46162) (with International Search Report) (22 sheets); International Preliminary Examination Report (8 sheets); Check in the amount of $990.00 (Filing Fee) based on large entity; Certificate of First Class Mailing (1 sheet); and Return Postcard.**

JC05 Rec'd PCT/PTO 0 3 AUG 2001

APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NO.
09/890681	PCT/GB00/00332	MCW-003US

17. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) .(a/o November 1, 2000):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....**$1000**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860**

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.455(a)(2)) paid to USPTO **$710**

International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4).....**$690**

International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4).....**$100**

CALCULATIONS PTO USE ONLY	
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00
Surcharge of **$130.00** for furnishing the oath or declaration later than ☒ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$130.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	**15**-20 =	**0**	X **$18.00**	$	
Independent claims	**2**-3 =	**0**	X **$80.00**	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **270.00**	$	
TOTAL OF ABOVE CALCULATIONS =				$990.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.				$	
SUBTOTAL =				$	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$990.00	
				Amount to be: refunded	$
				charged	$

a. ☒ Checks in the amount of $ **990.00** to cover the above fees are enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **12-0080**. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Anthony A. Laurentano, Esq.
LAHIVE & COCKFIELD, LLP
28 State Street
Boston, Massachusetts 02109
United States of America
(617)227-7400
Date: 03 August 2001

SIGNATURE

Anthony A. Laurentano
NAME

38,220
REGISTRATION NUMBER

IN THE UNITED STATES PATENT DESIGNATED OFFICE (DO/US)
(National Phase of International App.: PCT/GB00/00332, W/O 00/46162)

In re the application of:
Paulo Vicente DA SILVA MARQUES et al.

International Application No.: **PCT/GB00/00332**

International Filing Date: **07 February 2000**

U.S. Serial No.: **Not Yet Assigned**

Filed: **Herewith**

For: **BURNER FOR FABRICATING AEROSOL DOPED WAVEGUIDES**

Attorney Docket No.: **MCW-003US**

BOX PCT
Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

Preliminary to examination of the above-referenced patent application, please amend the enclosed above-titled International patent application as follows.

In the Claims

Please amend claims 3-6, 8-10, 12, 14 and 15 as follows:

3. (Amended) A burner as claimed in claim 1, wherein the gas expansion chamber is located at the junction of an inlet port and the respective torch conduit.

4. (Amended) A burner as claimed in Claim 1, wherein the gas expansion chamber is located upstream of the junction between the inlet port and the respective torch conduit.

5. (Amended) A burner as claimed in Claim 1, wherein the gas expansion chamber is located downstream of the junction between the inlet port and the respective torch conduit.

6. (Amended) A burner as claimed in claim 1, wherein said inlet ports feed oxygen, hydrogen, waveguide deposition material carried by a carrier gas, and aerosol droplets of a dopant ion solution carried by a carrier gas to the said burner.

8. (Amended) A burner as claimed in Claim 6, wherein the aerosol inlet port is located downstream of the hydrogen inlet port.

9. (Amended) A burner as claimed in Claim 6, wherein the oxygen inlet port is located downstream of the aerosol inlet port.

10. (Amended) A burner as claimed in claim 1, wherein said at least one inlet port is located in a radial plane with respect to a longitudinal axis of the burner which differs from a radial plane containing said other inlet ports.

12. (Amended) A burner as claimed in claim 1, wherein said at least one inlet port is orientated at a first angle with respect to the burner axis, and wherein the other inlet ports are orientated at a second angle with respect to the burner axis, said first angle being less than said second angle.

14. (Amended) A burner as claimed in Claim 12, wherein said first angle lies in the range 5° to 25°.

15. (Amended) A burner as claimed in claim 1, wherein said at least one inlet port is an aerosol inlet port for providing aerosol droplets of a dopant ion solution to said burner.

Please cancel claim 16.

REMARKS

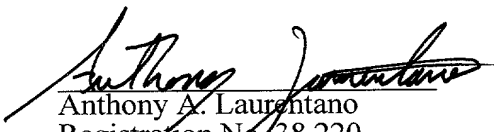
Applicants amend the claims to remove multiple dependencies, to provide proper antecedent basis, and to address other matters of form. The foregoing amendments introduce no new matter and are not related to issues of patentability.

Entry of the foregoing Preliminary Amendment is respectfully in order and requested.

If there are any questions regarding the amendments to the application, we invite the Examiner to call Applicants' representative at the telephone number below.

Respectfully submitted,

LAHIVE & COCKFIELD, LLP



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Date: **August 3, 2001**

Version With Markings To Show Changes Made

Please amend claims 3-6, 8-10, 12, 14 and 15 as follows:

1. A burner for fabricating aerosol doped waveguides, the burner including: a plurality of inlet ports each connected to a respective torch conduit, said torch conduit connecting its respective inlet port to a gas mixing region; and including a gas expansion chamber provided for at least one of said inlet ports upstream of said gas mixing region.

2. A burner as claimed in Claim 1, wherein the gas expansion chamber is in the form of a reservoir chamber.

3. A burner as claimed in ~~either preceding~~ claim 1, wherein the gas expansion chamber is located at the junction of an inlet port and the respective torch conduit.

4. A burner as claimed in Claim 1 ~~or 2~~, wherein the gas expansion chamber is located upstream of the junction between the inlet port and the respective torch conduit.

5. A burner as claimed in Claim 1 ~~or 2~~, wherein the gas expansion chamber is located downstream of the junction between the inlet port and the respective torch conduit.

6. A burner as claimed in ~~any preceding~~ claim 1, wherein said inlet ports feed oxygen, hydrogen, waveguide deposition material carried by a carrier gas, and aerosol droplets of a dopant ion solution carried by a carrier gas to the said burner.

7. A burner as claimed in Claim 6, wherein the hydrogen port is located downstream of the waveguide deposition material inlet port.

8. A burner as claimed in Claim 6 ~~or 7~~, wherein the aerosol inlet port is located downstream of the hydrogen inlet port.

9. A burner as claimed in ~~any one of~~ Claim~~s~~ 6 ~~to 8~~, wherein the oxygen inlet port is located downstream of the aerosol inlet port.

10. A burner as claimed in ~~any preceding~~ claim 1, wherein said at least one inlet port is located in a radial plane with respect to a longitudinal axis of the burner which differs from a radial plane containing said other inlet ports.

11. A burner as claimed in Claim 10, wherein said at least one inlet port is located in a plane orientated at 180° to the radial plane of the other inlet ports.

12. A burner as claimed in ~~any preceding~~ claim 1, wherein said at least one inlet port is orientated at a first angle with respect to the burner axis, and wherein the other inlet ports are orientated at a second angle with respect to the burner axis, said first angle being less than said second angle.

13. A burner as claimed in Claim 12, wherein said first angle lies in the range 5° to 45°.

14. A burner as claimed in Claim ~~13~~ 12, wherein said first angle lies in the range 5° to 25°.

15. A burner as claimed in ~~any preceding~~ claim 1, wherein said at least one inlet port is an aerosol inlet port for providing aerosol droplets of a dopant ion solution to said burner.

~~16. A burner substantially as described herein and with reference to Fig. 3 of the accompanying drawings.~~

BURNER FOR FABRICATING AEROSOL DOPED WAVEGUIDES

FIELD OF THE INVENTION

This invention relates to a burner for fabricating aerosol doped waveguides. In particular, the invention relates to a modified burner which enables the in-situ delivery of dopant ions in a single step process to an optical waveguide during the deposition stage of fabrication.

BACKGROUND OF THE INVENTION

The fabrication of silica based planar waveguides with high ion content by chemical vapour deposition (CVD), and in particular flame hydrolysis deposition (FHD) methods, is already known in the art.

In such fabrication methods it is often desired to introduce dopant ions during the deposition process. The introduction of dopant ions is effected by a number of known methods which suffer to a greater or lesser degree from certain disadvantages. For example, solution doping requires the core which makes up the waveguide to be partially fused and this introduces

several complications.

An alternative method is to use aerosol doping. In aerosol doping droplets of an aqueous solution of the dopant ions are transferred to a modified FHD burner. The water is evaporated to leave submicron dopant ion particles. The dopant ions are then oxidised in the burner flame and can be distributed during the deposition stage of fabricating the waveguide.

It is known to modify conventional FHD burners to incorporate an extra port for the aerosol feed. A problem arises, however, when such burners are used in the fabrication of heavily doped waveguides. High dopant ion levels require high concentrations of the aqueous dopant ion solution. During the evaporation of the solvent in highly concentrated solutions, more dopant ions condense around the aerosol inlet port than would do with a less concentrated solution. This build up of condensed ions can create blockages. The present invention seeks to provide a modified burner design which obviates or mitigates the problems heretofore mentioned.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a burner for fabricating aerosol doped waveguides, the burner including:

a plurality of inlet ports each connected to a respective torch conduit, said torch conduit connecting its respective inlet port to a gas mixing region; and including a gas expansion chamber provided for at least one of said inlet ports upstream of said gas mixing region.

Preferably, the gas expansion chamber is in the form of a reservoir chamber.

Preferably, the gas expansion chamber is located at the junction of an inlet port and the respective torch conduit.

Alternatively, the gas expansion chamber is located upstream of the junction between the inlet port and the respective torch conduit.

Alternatively, the gas expansion chamber is located downstream of the junction of an inlet port and the respective torch conduit.

Preferably, said inlet ports feed oxygen, hydrogen, waveguide deposition material carried by a carrier gas, and aerosol droplets of a dopant ion solution carried by a carrier gas to the said burner.

Preferably, the hydrogen port is located downstream of the waveguide deposition material inlet port.

Preferably, the aerosol inlet port is located downstream of the hydrogen inlet port.

Preferably, the oxygen inlet port is located downstream of the aerosol inlet port.

Preferably, said at least one inlet port is located in a radial plane with respect to a longitudinal axis of the burner which differs from a radial plane containing said other inlet ports.

Preferably, said at least one inlet port is located in a plane orientated at 180° to the radial plane of the

other inlet ports.

Preferably, said at least one inlet port is orientated at a first angle with respect to the burner axis, and wherein the other inlet ports are orientated at a second angle with respect to the burner axis, said first angle being less than said second angle.

Preferably, said first angle lies in the range 5° to 45°.

Preferably, said first angle lies in the range 5° to 25°.

Preferably, said at least one inlet port is an aerosol inlet port for providing aerosol droplets of a dopant ion solution to said burner.

DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described by way of example only, with reference to the drawings in which:

Fig. 1 is an FHD burner already known in the prior art;

Fig. 2 is a cross-section through an FHD burner of the type shown in Fig. 1; and

Fig. 3 is a cross-section through a modified FHD burner according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, Fig. 1 illustrates a FHD burner 1 already known in the art. The burner 1 has

four feed inlet ports: a halide inlet port 2, a hydrogen inlet port 3, an aerosol inlet port 4, and an oxygen inlet port 5. The halide inlet port 2 feeds the burner 1 with halide deposition materials, for example, $SiCl_3$, PCl_3, etc carried by a suitable carrier gas, for example, N_2. The inlet ports 2,3 4 and 5 communicate with a gas mixing region 8 at the output of the burner 1.

The aerosol inlet port 4 supplies aerosol droplets of a dopant ion solution, for example, 0.2 M aqueous $ErCl_3$. An atomizer 6 is used to generate the aerosol droplets of the dopant ion solution. The aerosol droplets are carried by a carrier gas, for example, N_2 to the aerosol inlet port 4 of the burner 1. The water solvent is then evaporated to leave submicron particles of the dopant ions (here Er^{+3}) which are prone to condense at the inlet port 4. For solution strengths above 0.2M, the build up of condensed dopant ions can create a blockage 7 which can clog the inlet port 4. This blockage 7 occurs before the dopant ions react in the gas mixing reaction zone 8, which affects the rate at which the dopant ions are incorporated during fabrication of a waveguide 9. The blockage 7 arises due to the combination of an abrupt reduction in pipe volume and the change in directionality of the carrier gas flow (θ = 68° from the torch axis (X in Fig. 1)).

Referring now to Fig. 2, there is shown a cross-section through this type of conventional burner 1. The inlet ports 2, 3, 4 and 5 are all aligned at the same angle θ to the torch axis X, and transfer the feed gases (the gas carrying the halide deposition materials, hydrogen, the gas carrying the dopant ions, and oxygen) into concentric torch conduits 10, 11, 12 and 13 respectively. The halide torch conduit 10, hydrogen

torch conduit 11, aerosol torch conduit 12, and oxygen torch conduit 13 deliver the feed gases to the gas mixing reaction zone 8 located in the burner nozzle 14 where the dopant ions are oxidised in the burner flame. The oxidised dopant ions are then incorporated during the deposition of the layers (not shown) which form the waveguide 9 (shown in Fig.1) a single step process.

Referring now to Fig. 3, there is shown a modified burner 15 made in accordance with the invention for introducing rare earth dopant ions, for example, Er^{+3}, during fabrication of a waveguide (not shown).

The burner 15 has four feed inlet ports: a halide inlet port 16, a hydrogen inlet port 17, an aerosol inlet port 18, and an oxygen inlet port 19. The halide inlet port 16 supplies the deposition materials, for example, $SiCl_3$, PCl_3, etc, which are carried by a suitable carrier gas, for example, N_2. The aerosol inlet port 18 supplies aerosol droplets of a dopant ion solution, for example, aqueous $ErCl_3$.

The halide inlet port 16, hydrogen port 17, and oxygen port 19 are located in the same radial plane radiating from the torch axis Y and can be all aligned at the same angle θ1 to the torch axis Y. The aerosol inlet port 18 is located in a different radial plane (for example, it may be displaced by 180° from the plane in which the inlet ports 16, 17 and 19 are located) and is positioned at a different angle θ2 with respect to the torch axis Y. The inlet ports 16, 17, 18 and 19 transfer the feed gases into respective concentric torch conduits 20, 21, 22 and 23. The halide torch conduit 20, hydrogen torch conduit 21, aerosol torch conduit 22, and oxygen torch conduit 23 deliver their respective feed gases to a gas mixing reaction zone 24

where the dopant ions, in this example Er^{+3}, are oxidised in the burner flame (not shown).

The aerosol inlet port 18 has a modified structure, compared to the aerosol inlet port 4 of prior art burner 1. The aerosol conduit 22 is expanded at the region where it connects with aerosol inlet port 18 to form a gas expansion chamber 25 (here in the form of a reservoir chamber). The gas expansion chamber 25 provides an increase in the volume of the aerosol inlet port 18 and helps to maintain the concentration of dopant ions and to mitigate the build up of condensed dopant ions during evaporation of the aqueous dopant ion solution.

The gas expansion chamber 25 enables the evaporation of the dopant ion solvent to occur without the dopant ions condensing at the base of the aerosol inlet port 18 forming a blockage at the base of the aerosol inlet port 18.

A suitable volume for the gas expansion chamber lies in the range of 2500 mm^3 to 5000 mm^3 for an aerosol feed carrier gas flow rate of 3 litres/min, an aerosol inlet port 18 internal diameter of 5.5 mm, and an aerosol conduit 22 internal diameter of 14 mm.

In the preferred embodiment, the gas expansion chamber 25 is circular in radial cross-section and elliptical in axial cross-section and is provided at the junction of the aerosol inlet port 18 with the aerosol torch conduit 22 by expanding the internal diameter of the aerosol conduit 22. Alternatively, the gas expansion chamber may have a different shape and/or configuration. It can also be located at other points where evaporation of the dopant ion solution occurs,

for example upstream along the aerosol inlet port 18 or downstream along the aerosol conduit 22.

The prevention of a blockage occurring as the dopant ions enter the aerosol conduit 22 is further assisted by reducing the angle of directionality θ2 (the angle the aerosol inlet port makes with the torch axis (Y in Fig. 3)). In the preferred embodiment, significant reduction in the amount of condensation is provided by θ2 being substantially equal to 10°, which is in a preferred range of 5° to 25°. A reduction in the amount of condensation is also achieved if θ2 is in the range of 25° to 45°.

The dimensions of the aerosol conduit 22 are selected to optimise the dopant process and to provide directionality to the flame whilst reducing the burner nozzle 26 temperature to below 1300°C. This prevents devitrification of the nozzle 26 which would otherwise provide unwanted contaminants.

In the preferred embodiment, with a deposition rate of 1 μm of base material per traversal of the FHD burner, it is possible to achieve doping levels of up to 0.72 wt% for an $ErCl_3$ solution strength of 1M with a carrier gas flow rate of 2.4 litre min^{-1}. Higher dopant levels can be achieved, for example, by maintaining the rare earth dopant conditions and reducing the halide flow rates or by increasing the concentration of the rare earth dopant solution.

Other dopant ions, for example, rare earth or heavy metal ions and combinations of ions can incorporated using the burner 15 into the deposition stage. Suitable solutions including rare earth and/or heavy metal ions can be prepared at much higher

concentrations than were hitherto known in the art without any accretion clogging the burner 15.

For example, a Nd doped planar silica (SiO_2 - P_2O_5) waveguide can be fabricated using the burner 15. An Nd/Al aqueous solution of 0.5M/0.4M can be used to provide the waveguide with dopant ion concentrations of 0.25 wt% for Nd and 0.04 wt% for Al.

The modified FHD burner 15 therefore enables greater control of the ion doping process during the deposition stage of fabricating the waveguide. One or more ion species can be introduced during the deposition stage of fabricating the waveguide in a controlled manner to produce waveguides with more uniform and much higher dopant ion concentrations than known from the prior art.

While several embodiments of the present invention have been described and illustrated, it will be apparent to those skilled in the art once given this disclosure that various modifications, changes, improvements and variations may be made without departing from the spirit or scope of this invention.

Claims:

1. A burner for fabricating aerosol doped waveguides, the burner including:

a plurality of inlet ports each connected to a respective torch conduit, said torch conduit connecting its respective inlet port to a gas mixing region; and including a gas expansion chamber provided for at least one of said inlet ports upstream of said gas mixing region.

2. A burner as claimed in Claim 1, wherein the gas expansion chamber is in the form of a reservoir chamber.

3. A burner as claimed in either preceding claim, wherein the gas expansion chamber is located at the junction of an inlet port and the respective torch conduit.

4. A burner as claimed in Claim 1 or 2, wherein the gas expansion chamber is located upstream of the junction between the inlet port and the respective torch conduit.

5. A burner as claimed in Claim 1 or 2, wherein the gas expansion chamber is located downstream of the junction between the inlet port and the respective torch conduit.

6. A burner as claimed in any preceding claim, wherein said inlet ports feed oxygen, hydrogen, waveguide deposition material carried by a carrier gas, and aerosol droplets of a dopant ion solution carried by a carrier gas to the said burner.

7. A burner as claimed in Claim 6, wherein the hydrogen port is located downstream of the waveguide deposition material inlet port.

8. A burner as claimed in Claim 6 or 7, wherein the aerosol inlet port is located downstream of the hydrogen inlet port.

9. A burner as claimed in any one of Claims 6 to 8, wherein the oxygen inlet port is located downstream of the aerosol inlet port.

10. A burner as claimed in any preceding claim, wherein said at least one inlet port is located in a radial plane with respect to a longitudinal axis of the burner which differs from a radial plane containing said other inlet ports.

11. A burner as claimed in Claim 10, wherein said at least one inlet port is located in a plane orientated at 180° to the radial plane of the other inlet ports.

12. A burner as claimed in any preceding claim, wherein said at least one inlet port is orientated at a first angle with respect to the burner axis, and wherein the other inlet ports are orientated at a second angle with respect to the burner axis, said first angle being less than said second angle.

13. A burner as claimed in Claim 12, wherein said first angle lies in the range 5° to 45°.

14. A burner as claimed in Claim 13, wherein said first angle lies in the range 5° to 25°.

15. A burner as claimed in any preceding claim, wherein said at least one inlet port is an aerosol inlet port for providing aerosol droplets of a dopant ion solution to said burner.

16. A burner substantially as described herein and with reference to Fig. 3 of the accompanying drawings.

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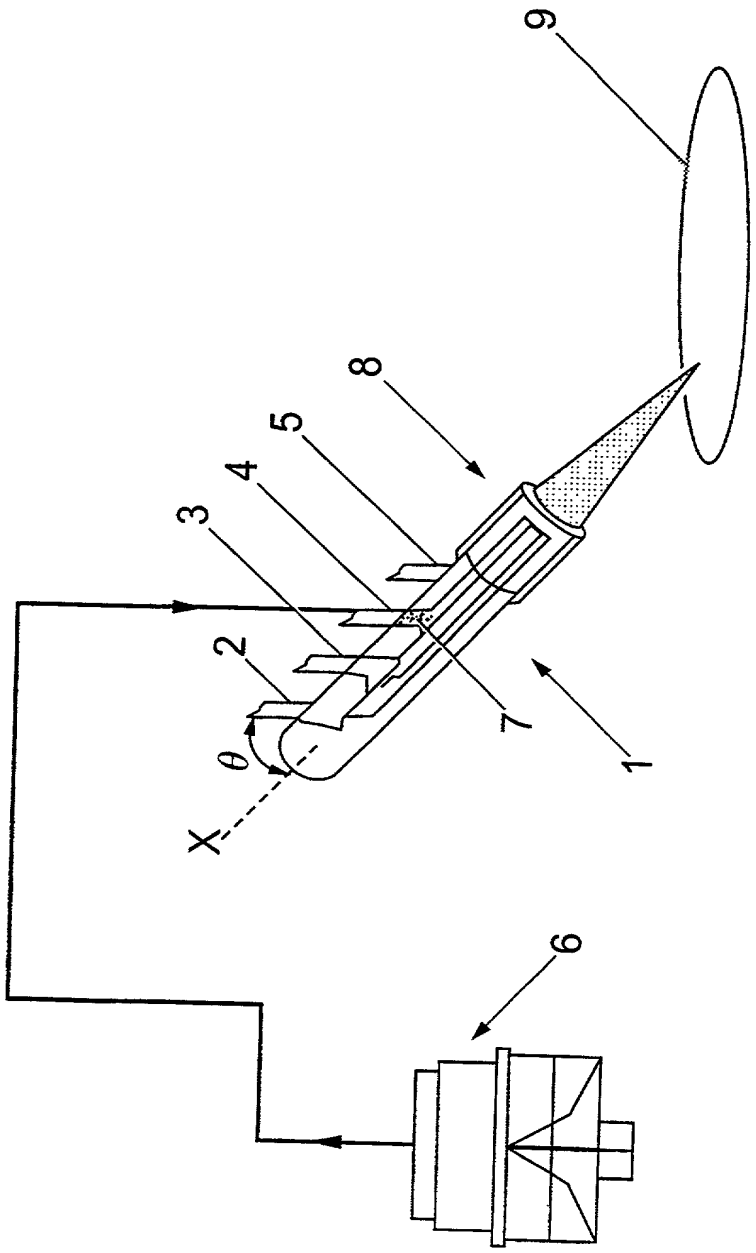

Fig. 1

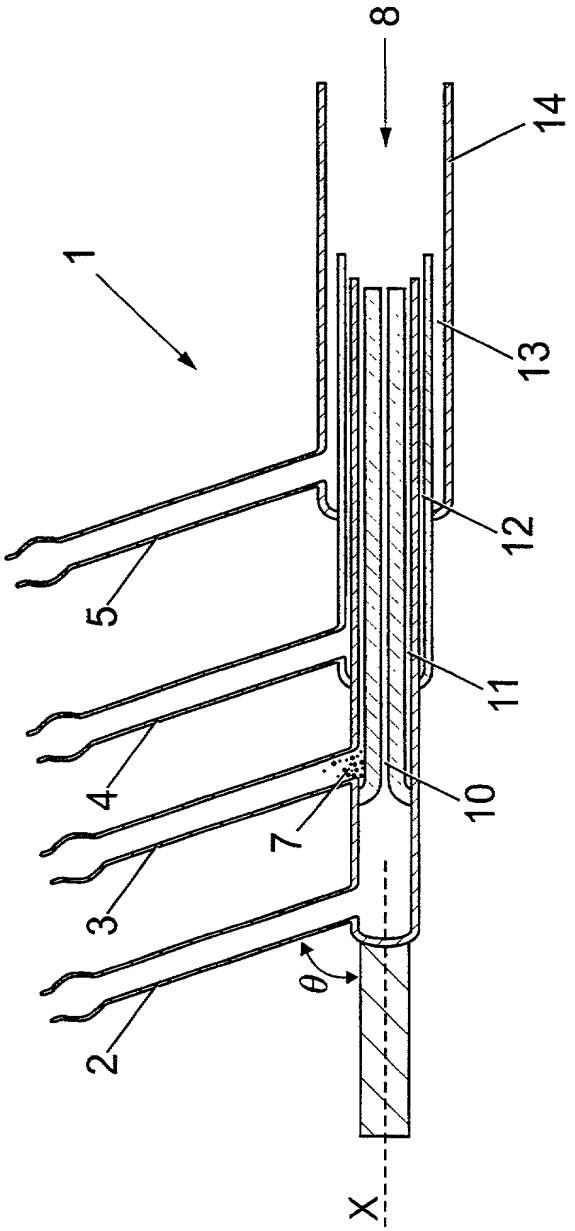

Fig. 2

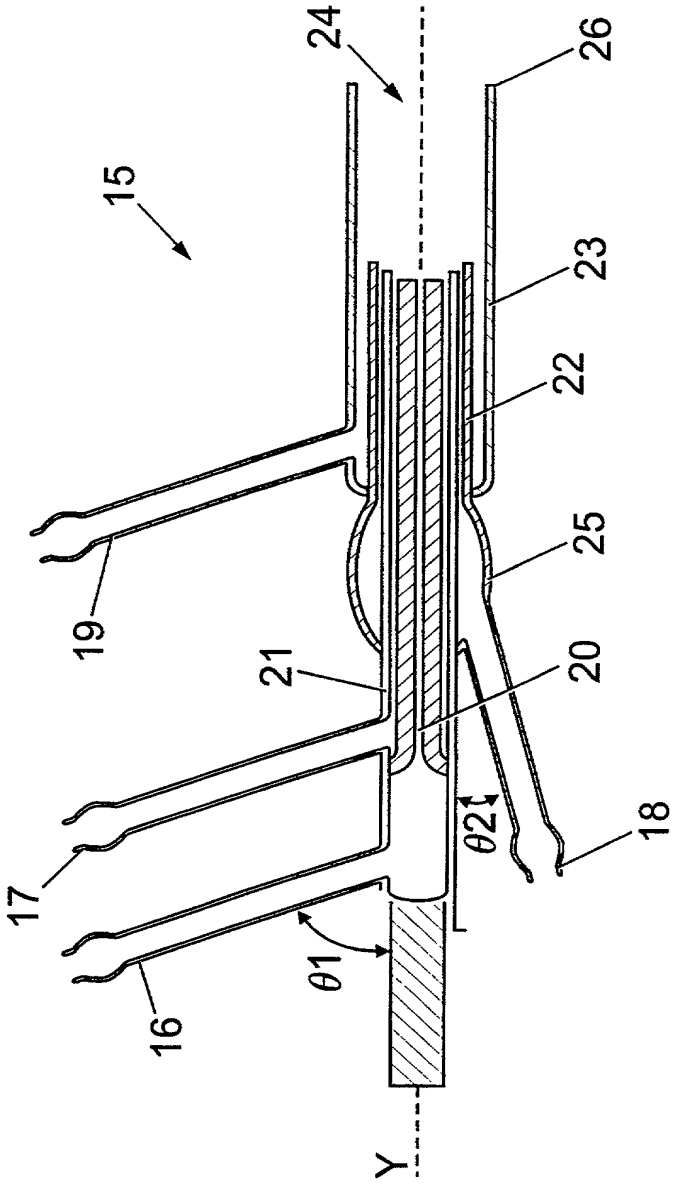

Fig. 3

Atty Docket No.: **MCW-003US**

DECLARATION, PETITION AND POWER OF ATTORNEY FOR PATENT APPLICATION

(Check one):

- ☐ Declaration Submitted with Initial Filing
- ☒ Declaration Submitted after Initial Filing

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

BURNER FOR FABRICATING AEROSOL DOPED WAVEGUIDES

the specification of which (check one):

☐ is attached hereto.

OR

☒ was filed on **07 February 2000** as PCT International Application Number **PCT/GB00/00332** and as **U.S. Serial No. 09/890,681**.

- ☐ and was amended by PCT Article 19 Amendment on _____ (if applicable).
- ☐ and was amended by PCT Article 34 Amendment on _____ (if applicable).

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby state that I have reviewed and understood the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

PRIORITY CLAIM

(Check one):

☐ no such applications have been filed.

☒ such applications have been filed as follows

1) **FOREIGN PRIORITY CLAIM:** I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate or §365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (dd/mm/yyyy)	Priority Not Claimed	Certified Copy Attached Yes	Certified Copy Attached No
9902476.2	GB	05 February 1999 (05.02.1999)	☐	☐	☒
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority sheet attached hereto.

2) **PROVISIONAL PRIORITY CLAIM:** I hereby claim the benefit under Title 35, United States Code §119(e) of any United States provisional application(s) listed below.

Provisional Application Number(s)	Filing Date (dd/mm/yyyy)

☐ Additional provisional application numbers are listed on a supplemental priority sheet attached hereto.

3) **U.S./PCT PRIORITY CLAIM:** I hereby claim the benefit under Title 35, United States Code, §120 of any United States application or §365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (dd/mm/yyyy)	Parent Patent Number *(if applicable)*

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority sheet attached hereto.

POWER OF ATTORNEY:

As a named inventor, I hereby appoint the following attorneys and/or agents to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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Wherefore I petition that letters patent be granted to me for the invention or discovery described and claimed in the attached specification and claims, and hereby subscribe my name to said specification and claims and to the foregoing declaration, power of attorney, and this petition.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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